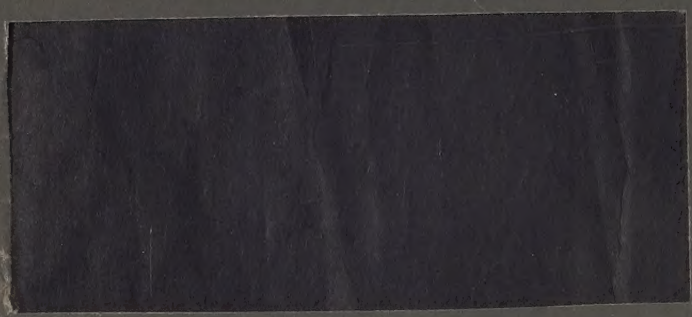
J. KAYE + Co., Inc

MANUAL
for
Model 4200
Viscometer Bath
FSN 4931-420-9036

RETURN TO 517th MAINT BN ZWEIBRUECKEN



MANUAL
for
Model 4200
Viscometer Bath
FSN 4931-420-9036

Document No. 4200

Under Contract No. DAAG31-69-C-0829

Prepared for:

U.S. Army Metrology & Calibration Center
Redstone Arsenal, Alabama 35809

Prepared by:

Joseph Kaye & Company, Incorporated
737 Concord Avenue
Cambridge, Massachusetts 02138

1. Complete Specifications and Tolerances for Model 4200 Viscometer Bath.

1.1 Design and Construction

1.1.1 Bath Material. The bath is constructed of Plexiglass G.

1.1.2 Dimensions. The inside bath dimensions are: 3" x 3" x 11" deep. These dimensions have a tolerance of ± 1/32". The dimensions of the complete unit, including handle, feet and other protuberances are 14" high x 16" deep x 7" wide.

1.1.3 Weight. Total weight of the bath (dry) is approximately 38 pounds.

1.1.4 Window. The window provides a viewing area 2-3/4" wide by 10-1/4" high. This provides clear visibility of both viscometers and thermometers.

1.1.5 Top. The top is removable by releasing two thumb screws. The seal on the top is permanently bonded. The viscometers and thermometers are held in place by insertion into the clamps on the top cover.

1.1.6 Cooler. The bath's cooling system is capable of cooling the bath from 75° F to 50° F in a maximum of 4 hours in a 75° F ambient. Thermoelectric cooling is employed. Liquid circulation is achieved by an internally mounted circulation pump. The thermoelectric module heat sink is cooled by forced convection.

1.1.7 Heater. The bath is heated by a 250 watt cartridge heater installed in the heat exchanger. The heater is powered on 115 Volt, 60 Hertz through the controller.

1.2 Performance

1.2.1 Temperature range. The bath is capable of operation between 50° F and 150° F.

1.2.2 Temperature control. The temperature of the bath (water or oil) can be controlled within ± 0.05° F over a temperature range of 50° F to 150° F.

1.2.3 Environmental and service conditions. The unit will operate satisfactorily under all of the environmental conditions specified herein.

1.2.4 Operational environment. The equipment will operate as specified after thermally stabilizing over the following range of environmental conditions:

1.2.4.1 Relative humidity from 0 percent to 90 percent.

1.2.4.2 Temperature from 60° F to 80° F.

1.2.4.3 Altitude from 0 to 1,000 feet above sea level.

1.2.5 Non-operational environment. The equipment will operate after being subjected to the following conditions:

1.2.5.1 Stored for 48 hours at minus 55° centigrade.

1.2.5.2 Stored for 48 hours at plus 60° centigrade.

1.2.5.3 Stored for 48 hours at 40,000 feet above sea level.

1.2.6 Shock and Vibration.

1.2.6.1 Tilt drop. The unit is capable of operating satisfactorily without permanent damage or degradation of accuracy after being subjected to a tilt drop test on each of its ends, using the opposite end as a pivot, for a distance of at least 4 inches above the horizontal plane with a free drop to a solid surface.

1.2.6.2 Vertical and lateral shock. The unit is capable of operating as specified herein after being subjected to a vertical and lateral shock of 15 gravity units half sine pulse with a duration of 11 milliseconds. The test is performed with the bath in its carrying case.

1.2.6.3 Vibration. The vibration test is performed with the bath mounted in its carrying case. The unit is capable of operating as specified herein after being subjected to vibration with the frequency varying logarithmically between 5 to 500 hertz at the following levels:

1.2.6.3.1 5-27 Hertz, 1.3 gravity units ± 0.05 gravity units.

1.2.6.3.2 27-52 Hertz, 0.036 ± 0.001 inches double amplitude.

1.2.6.3.3 52-500 Hertz, 5.0 gravity units ± 0.05 gravity units.

1.2.6.4 Identification. The unit is identified in accordance with MIL-STD-120

2. Detailed Theory of Operation.

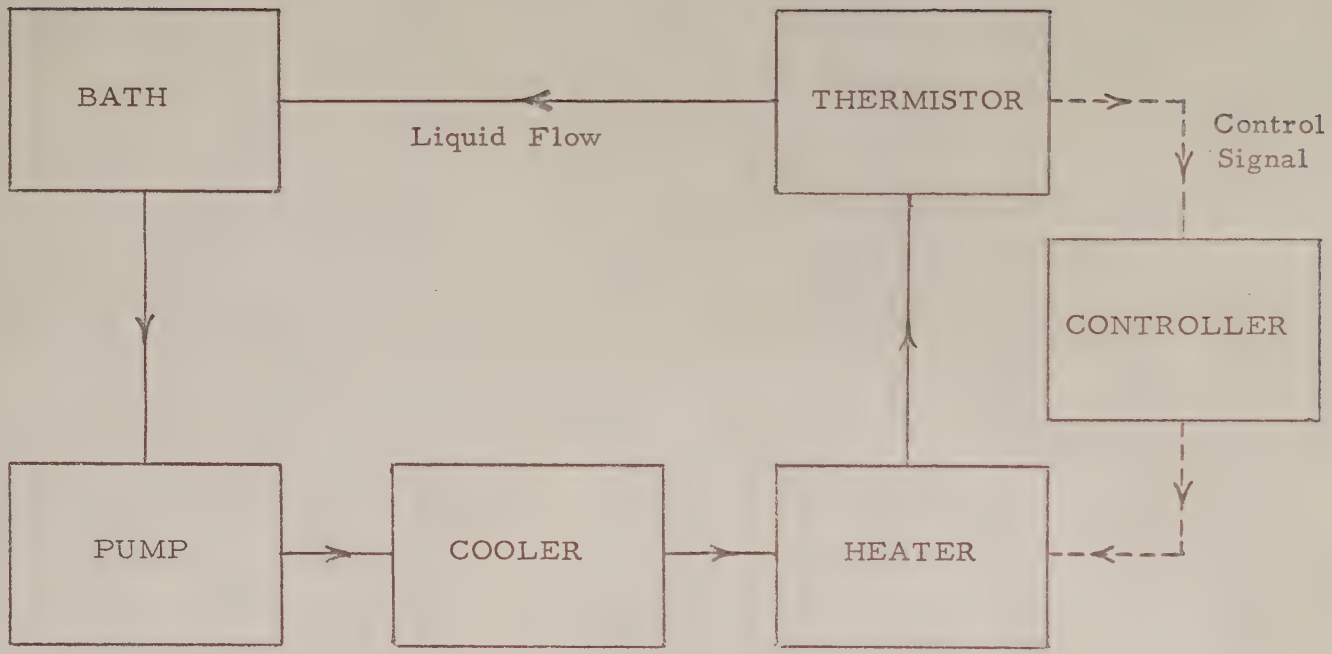
2.1 The Model 4200 Viscometer Bath is completely self-contained and portable, designed for use with ASTM type viscometers, Models 25 through 400. The front face is transparent, providing clear visibility of the viscometers and thermometers in the test section. The unit contains a circulation pump, a heat exchanger assembly which contains a thermoelectric refrigeration unit and an electric resistance heater, a thermistor sensor, and a bridge type temperature controller. When the unit is turned on, the circulation pump takes fluid from the bottom of the test tank and forces it through the heat exchanger, past the thermistor sensor and then back into the top of the tank. The refrigeration system runs continuously. Thus the operating temperature is established by controlling only the heat addition. The heater has been sized to easily overpower the cooling system. The pilot light located above the On/Off switch is wired in parallel with the heater; thus, when the controller calls for heat, the pilot light will be "ON". The control set point is established by the control knob located on the front of the unit. This knob is connected to a ten turn potentiometer, which is a part of the controller bridge along with the thermistor probe. Because of the vigorous mixing action of the streams entering and exiting from the test section, no additional stirring is required to maintain a uniform temperature in the bath.

3. Instrument Block Diagram

3.1 Drawing A-4200-23 is a block diagram of the Viscometer Bath.

Drawing No. A-4200-23

BLOCK DIAGRAM OF INSTRUMENT OPERATION



4. Operating Instructions

4.1 Introduction

Operation of the bath can be considered in four phases, namely:

(1) start-up (2) temperature control (3) testing (4) shut-down.

4.2 Start-up

4.2.1 Remove the bath cover-holder by releasing the two thumb screws.

4.2.2 Fill the bath with water to a level of about 1-1/4" from the top.

4.2.3 Connect the line cord to a standard 117 VAC outlet.

4.2.4 Turn the ON/OFF switch to "ON".

4.2.5 The critical parameter to test is whether or not the pump is circulating fluid. This is usually evident by initial bubble motion in the test section. If there is any question, place a finger in the bath to sense the flow of liquid from the inlet port. If the pump is not circulating, turn the unit off, unplug and drain. The pump is not self-priming. If the unit has been completely drained, water trapped in the heat exchanger can cause the pump to be air-locked. See 4.5 for proper draining procedure. With the pump circulating, you are ready for step (4.3).

4.3 Temperature Control

4.3.1 Depending on the desired operating temperature, a suitable thermometer along with the viscometers should be selected and installed in the bath. Four compression clamps are installed on the bath cover. The two large clamps are for suspension of viscometers; the two small clamps are for suspension of thermometers. The viscometers and thermometers should be rigidly secured in these clamps for their support in the bath. After this has been done, the cover-holder should be replaced and the thumb screws tightened.

4.3.2 The control condition is indicated by the pilot light. There are three conditions for the pilot light: "OFF", "Flickering" and "ON". A few seconds of experimentation with the control knob will allow one to locate the "flickering" position. "Flickering" indicates the region of proportional control. "ON" is continuous

heating and "OFF" is cooling only. It is now a fairly simple matter to bring the bath onto the desired control point by monitoring the thermometer and making corresponding adjustments with the control knob.

4.4 Testing. With the bath on temperature the viscosity tests can be run.

4.5 Shut-down.

4.5.1. Turn unit off.

4.5.2 Disconnect power.

4.5.3 Remove drain plug on front of unit.

4.5.4 Remove cover-holder.

4.5.5 After draining, insert blowout tube into tank inlet. Take a deep breath and blow through tube. This will clear water from the heat exchanger and thus permit proper start-up. (Tank inlet is the upper connection).

4.5.6 Remove blowout tube.

4.5.7 Replace drain plug.

4.5.8 Replace cover-holder after removing viscometers and thermometers.

5. Instrument Calibration. As this unit is to be used with calibrated thermometers for establishing the bath temperature, there are no non-operating calibration requirements.

6. Instrument Maintenance Checks and Adjustments. The instrument requires no routine maintenance checks or adjustments.

7. Trouble Shooting Instructions

7.1 The following table lists a series of malfunction symptoms. Beside the symptoms are a list of probable causes and checks for malfunction isolation.

TABLE 7.1

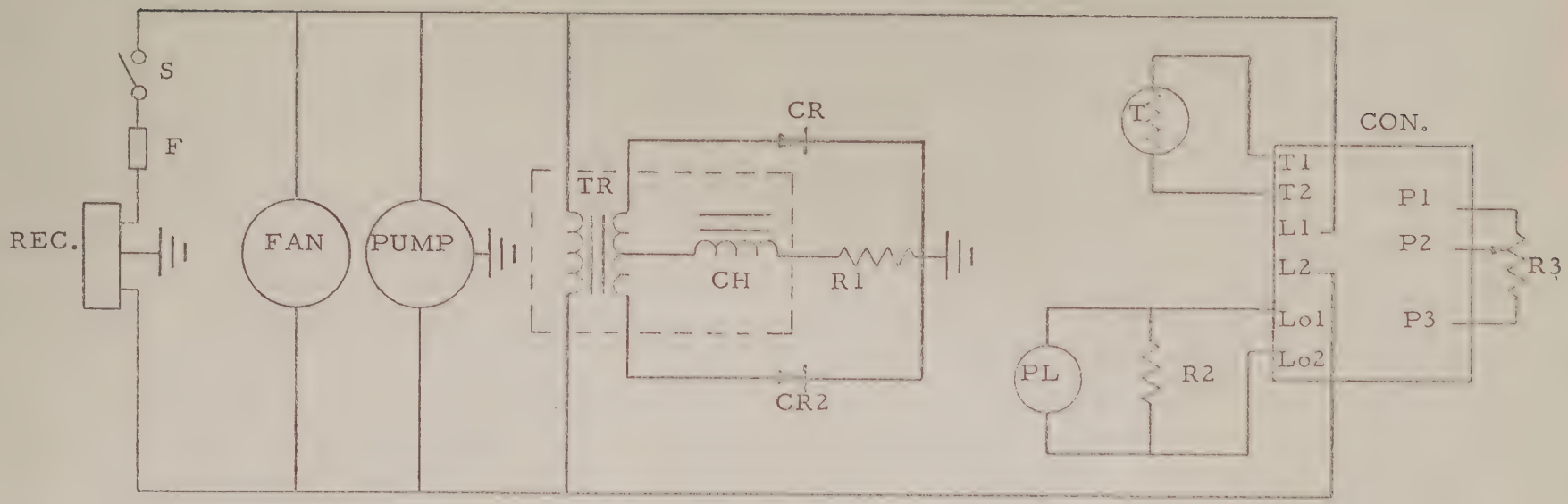
SYMPTOM	CAUSE	INSTRUCTION
Blown fuse	Short	1. Examine wiring for shorts. 2. Test resistances of fan, pump, heater. (Refer to Dwg. B-4200-24)
Water does not circulate	Pump	1. Read operating instructions, pump may be air-locked. 2. Check out pump operation.
Loss of water	Leak	1. Examine tank, hose lines, pump and heat exchanger assembly for leaks.
	Evaporation	1. High temperature operation will result in small evaporative water losses, add a little, as necessary.
Loss of temperature control	Controller	1. If Pilot light is "ON" or "OFF" under all conditions a failure of the controller is indicated. 2. Test thermistor, heater and potentiometer resistances. (Refer to Dwg. B-4200-24)
Screech sound	Pump	1. Experience has shown that the pump impeller bearing must wear-in. During this period, occasional bearing noises, though disturbing, are not damaging. Let the unit run as long as water continues to circulate. Wear-in is usually complete after 50 hours of operation.
Inadequate cooling	Heat exchanger assembly or power supply	1. Test module voltage -- should be about 5 VDC, if ok, defective thermoelectric modules in heat exchanger section are indicated.

8. Diagram.

8.1 Drawing No. B-4200-24 is an electrical schematic of the Viscometer Bath.

VISCOMETER BATH

ELECTRICAL SCHEMATIC



Refer to Page 10 for Legend

LEGEND

Drawing No. B-4200-24

Symbol	Item No.	Description
CON	25	Controller, 50F-150F, Load 115 VAC at 500 watt max.
CR1, CR2	27	Diode 100V, 15 amp.
F	16 & 17	Fuse and Fuseholder, 5 amp. slo blo
FAN	15	Fan 115 VAC, 19 watts
PL	12	Pilot Light, neon, 115 VAC
PUMP	22	Pump, 115 VAC, 1/170 HP
R1	23	Thermoelectric module, 15 amp., 32 couple
R2	24	Heater, 115 VAC, 250 watts
R3	18	Potentiometer, 2000 Ω, 10-turn
REC	20	Receptacle, 3 wire, 115 VAC, 7 amps.
S	11	On-Off Switch, SPST, 15 amp at 125 VAC
T	26	Thermistor Probe 50F-150F (6500 Ω nom at 72F)
TR-CH	21	Transformer-Choke, Primary 117V. 60 cps, Secondary 12 V, 15 amp. CT thru choke.

Terminal Number	Terminal Block Connections
0	Module Ground, Pump Ground, Chassis Ground
1	Module, Transformer-Choke
2	L01, Pilot Light, Heater
3	L02, Pilot Light, Heater
4	Fuse, On-Off Switch
5	Jumper, On-Off Switch, L1, Pump
6	Jumper, Transformer-Choke, Fan
7	Jumper, Receptacle, L2, Pump
8	Jumper, Transformer-Choke, Fan
9	Spare

9. Sub-Assemblies. There is one sub-assembly, the heat exchanger, in this unit. The sub-assembly and its components are listed on the component parts list.

10. Component Parts List.

10.1 The following two pages contain the component parts list.

COMPONENTS PARTS LIST (1)

4200

Item No.	JKCo Stock No.	Description	FSCM	Manufacturer or Supplier	Mfr's Part No.	Qty
1	1-1682	Tank, JK dwg.#D-4200-1	17466	Joseph Kaye		1
2	1-1683	Chassis, JK dwg.#D-4200-2	"	" "		1
3	1-1684	Cover, JK dwg.#D-4200-8	"	" "		1
4	8-1703	Heat Exchanger Assembly, JK dwg #C-4200-19-A-1	"	" "		1
5	1-1685	Heat Sink, JK dwg.#C-4200-4	"	" "	(Asy A-1*)	1
6	1-1686	Power Supply Chassis, JK dwg.#C-4200-13	"	" "		1
7	1-1687	Switch Bracket, JK dwg.#B-4200-3	"	" "		1
8	1-1704	Heat Exchanger, JK dwg.#B-4200-5	"	" "	(Asy A-1*)	1
9	1-1688	Pump Bracket, JK dwg.#A-4200-17	"	" "		1
10	1-1689	Cover-Holder, JK dwg.#A-4200-30	"	" "		1
11	2-1227	On-Off Switch, SPST, 15 amp at 125 VAC	04009	Arrow-Hart & Heggeman	82601	1
12	2-1690	Pilot Light, neon, 115 VAC	91802	Industrial Devices	1010 A3	1
13	6-1033	Handle	71279	Cambridge Thermionic	2385-2-18	1
14	5-1585	Drain Screw, 1/4-20x3/8 Pan Head Seelscrew, 18-8SS		Acc. Fastener		1
15	2-1691	Fan 115 VAC, 19 watts	81041	Howard Ind.	3-90-8010	1
16	2-1021	Fuse holder, 15 amp at 250 volts	71400	Bussmann Mfg.	HKP	1
17	2-1692	Fuse, MDL 5 (formerly 3AG-SB, 5 amp)	"	" "	MDL5	1
18	2-1693	Potentiometer, 2000 Ω 10-turn	80294	Bourns	3500S-1-202	1
19	2-1694	Power Cord, 3 wire, 115 VAC, 7 amps	70903	Belden	17258	1
20	2-1695	Receptacle, 3 wire, 115 VAC, 7 amps	82389	Switchcraft	AC3G	1

*(Assembly A-1)

COMPONENTS PARTS LIST (2)

4200

Item No	JKCo Stock No.	Description	FSCM	Manufacturer or Supplier	Mfr's Part No.	Qty
21	2-1696	Transformer-Choke, Primary 117 V. 60 cps. Secondary 16 V, 15 amp. CT thru choke	11850	Titan Transfor.	TT7454A	1
22	2-1697	Pump, 115 VAC, 1/170 HP	21198	March Mfg.	1A-MB 3/8	1
23	3-1317	Thermoelectric module, 15 amp, 32 couple	13656	Melcor (Asy A-1*)	MC 3.3-32-16	3
24	2-1698	Heater, 115 VAC, 250 watts	65586	E.L.Wiegand	RIL-25 (Asy A-1*)	1
25	2-1699	Controller, 50F-150F, Load 115 VAC at 500 watt max.	73168	Fenwall	19-201142-437	1
26	2-1700	Thermistor Probe 50F-150F (6500 Ω nom at 72F)	"	"	28-230806-700	1
27	2-1701	Diode 100V, 15 amp	05277	Westinghouse	366B	2
28	6-1708	Rubber Hose, Gum Rubber, 3/8 ID x 1/8 Wall)	97112	I.B.Moore		3
29	2-1390	Terminal Block p pt, 15 amp.	71785	Cinch-Jones	9-164	1
30	6-1156	Recess Bumper	70485	Atlantic India	18	4
31	6-1453	Bushing	28520	Heyman	SB87510	1
32	2-1702	Knob, 1" Dia.	75376	Kurz-Kasch	S-1748-3L	1
33	6-1709	Gasket, pump bracket, JK dwg.#A-4200-20	17466	Joseph Kaye		1
34	1-1710	Blowout Tube, JK dwg.#A-4200-21	"	" "		1
35	1-1711	Entrance Bend, JK dwg.#A-4200-22	"	" "		1
36	1-1712	Foam Box, JK dwg.#C-4200-6	"	" "	(Asy A-1*)	1
37	5-1357	10-32x2-3/4 Rd Hd MS, stl/cad		Acc.Fastener		4
38	5-1437	10-32x2-1/4 Rd Hd MS, stl/cad		" "		2
39	5-1333	10-32x1-3/4 Rd Hd MS, stl/cad		" "		2
40	5-1713	10-32 x 1 Rd Hd MS, stl/cad		" "		3
41	5-1714	10-32x5/8 Rd Hd MS, stl/cad		" "		2

* (Assembly A-1)

COMPONENTS PARTS LIST (3)

4200

Item No	JKCo Stock No.	Description	FSCM	Manufacturer or Supplier	Mfr's Part No.	Qty
42	5-1072	10-24x3/8 Rd Hd MS, stl/cad		Acc. Fastener		6
43	5-1356	10-32x3/8 Rd Hd MS, stl/cad		" "		8
44	5-1626	10-32x3/8 Pan Hd MS, Phillips stl/ni		" "		6
45	5-1452	6-32x1 Rd Hd MS, Phillips, stl/ni		" "		5
46	5-1177	6-32x1/2 Rd Hd MS, Phillips stl/ni		" "		8
47	5-1121	10-32 Hex Nut, stl/cad		" "		5
48	5-1069	6-32 Hex Nut, stl/cad		" "		14
49	5-1715	10-32 Thumb nut, brass/ni		" "		2
50	5-1065	#10 Int tooth lock washer		" "		7
51	5-1070	#6 Int tooth lock washer		" "		13
52	5-1439	Spacer #10x1/4, stl/cad	00287	C. E. M.	#10x1/4	6
53	1-1729	Doughnut, JK dwg. #A-4200-40	17466	Joseph Kaye		24
54	1-1730	Cover Gasket, JK dwg. #A-4200-41	"	" "		1
55	5-1731	Clamp, Compression	59730	Thomas & Betts	2523	2
56	5-1732	Bracket, Thermometer	48619	Prec. Scientific	502241	2
57	5-1733	Coupling, Thermometer	"	" "	501357	2

11. Special Tools

11.1 Blowout Tube, Item No. 34, JK Stock No. 1-1710, the only special tool required for operation or maintenance is supplied with the unit. See 4.5 for use.

12. Safety Precautions and Health Hazard Warnings

12.1 Safety Precautions

12.1.1 Hose lines are in the cabinet with electrical components. Therefore, should a hose ever break or leak during operation, the unit should be shut down and unplugged, immediately.

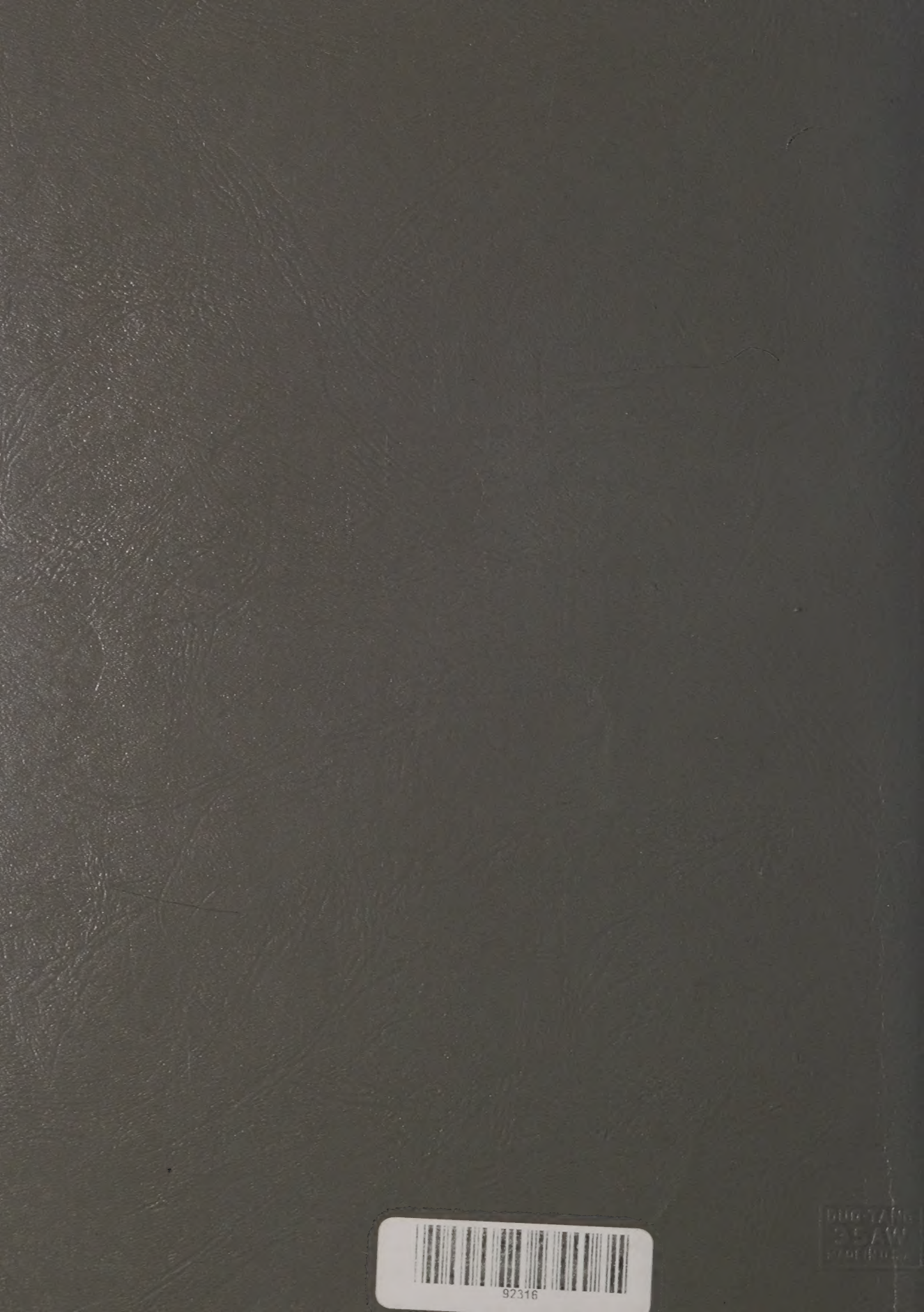
12.1.2 When trouble-shooting with the cover removed from the unit, never operate the unit for more than two minutes. The thermoelectric module heat sink must be cooled by forced convection which does not take place when the cover is removed.

12.2 Health Hazard Warnings. No unordinary health hazards are known beyond those which apply to normal electrical equipment.

13. This manual applies to Serial Numbers 1 through 100.

Recommended Provisioning List

Item No.	Description	FSCM	Unit Cost	Recommended Quantity
21	Transformer-Choke	11850	$ 80.00	1
4	Heat Exchanger Assembly, JK dwg.#C-4200-19-A-1	17466	345.00	3
26	Thermistor Probe 50° F-150° F	73168	25.00	3
25	Controller, 50° F-150° F	73168	165.00	3
22	Pump, 115 VAC, 1/170 HP	21198	39.50	3
1	Tank, JK dwg.#D-4200-1	17466	130.00	3
14	Drain Screw, 1/4-20x3/8 Pan Head Seelscrew, 18-8SS	-	0.35	10


92316